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AUTHOR van Kraayenoord, Christina E.
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AVAILABLE FROM Christina E. van Kraayenoord, Schonell Special Education Research Centre, University of Queensland, Queensland 4072, Australia.
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ABSTRACT

This study used a longitudinal design to examine the possibility of a causal link between metacognitive knowledge and reading performance across time in a group of grade 2 Australian children (1989 cohort, N=100; 1990 cohort, N=90) with and without learning disabilities. Revaluation between 1 and 2 years later found: no relationship between children's metacognitive knowledge about reading from one year to the next; group membership influenced almost all reading and metacognitive variables; accuracy and comprehension scores changed positively over time; there was no consistent relationship between metacognition and comprehension; and there were inconsistent results regarding the relationship between the two metacognitive constructs (metacognitive knowledge about reading and print awareness) particularly investigated. (46 references) (DB)

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Christina E. van Kraayenoord
Schonell Special Education Research Centre
The University of Queensland
Queensland 4072 Australia

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Running Head: Metacognitive knowledge

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Metacognitive Knowledge and Reading of Pupils with Learning Disabilities

Metacognition refers to knowledge or awareness of thinking and the control of thinking. When applied to reading (the active construction of meaning, Tierney & Pearson, 1984), one aspect of metacognition, that is metacognitive knowledge, is concerned with the explicit knowledge of the different factors that influence reading. Flavell (1978; 1979) has proposed that metacognitive knowledge comprises awareness of person, task and strategy variables and the ways in which these factors influence cognitive tasks, such as reading. The other main aspect of metacognition involves cognitive self-regulation. The activities or processes involved in the regulation of reading to comprehend include checking, planning, monitoring, testing, revising and evaluation (Brown, 1978; 1987).

Brown (1980) has suggested that metacognitive abilities contribute to reading development, while a number of authors have argued that metacognition plays an important role in reading and in comprehension in particular (e.g., Brown, 1980; Forrest-Pressley & Waller, 1984; Garner, 1987). While it is possible to examine either or both of the two aspects comprising metacognition, the study described in this paper and the research reviewed is limited to the factor of metacognitive knowledge in the domain of reading.

An examination of studies of metacognitive knowledge and reading in the literature reveals that there has been a reliance on cross-sectional studies with age and/or ability being the main units of analysis. Most of these studies have also sought to establish relationships between metacognitive factors and reading performance by reporting correlations (e.g., Forrest-Pressley & Waller, 1984; Garner & Kraus, 1981-1982).

Kurtz and Borkowski (1984) have called for the use of longitudinal designs to investigate causal links between metacognitive variables and performance. Since the mid 1980's there have been an increasing number of longitudinal studies in reading (e.g., Juel, Griffith & Gough, 1986; Juel, 1988; Mommers, 1987; Perfetti, Beck, Bell, & Hughes, 1987; Schneider & Näslund, in press; Skowronek & Marx, 1989; Weinert, Knopf, Körkel, Schneider, Vogel & Wetzel, 1984). Some of these have involved correlational designs (e.g.,

Juel, Griffith & Gough, 1986), while others have used causal modelling (Schneider & Näslund, in press).

While the number of longitudinal studies of reading and factors related to reading (e.g., phonemic awareness, concepts of print) is increasing, a search of the literature has failed to find any longitudinal studies that have investigated metacognitive knowledge of reading in pupils with learning disabilities, or that have examined the metacognitive knowledge about reading–reading comprehension relationship for more than one year on the same sample of children. The intention of this study was therefore to examine metacognitive knowledge and reading performance across time in a sample of children with learning disabilities and their normally achieving peers. The relationship between two variables of metacognitive knowledge, in particular concepts about print and metacognitive knowledge about reading was also of interest. Finally, the role of metacognitive knowledge as a predictor of later reading comprehension achievement was investigated.

However, in order to give a context for this study, a brief review of the literature examining metacognitive knowledge and reading in cross-sectional and short-term longitudinal studies is provided.

Many early studies of metacognitive knowledge were concerned with examining the developmental changes in children's awareness of concepts of print, concepts about reading and the nature of reading. Paris, Wasik and Turner (1991) have written a detailed review of these studies, however brief mention is made of some of the research here.

Studies of children's awareness of concepts of print (e.g., directionality, punctuation, word boundaries) found that young children (i.e., three year olds) lacked knowledge of print conventions, however by about age five many children were beginning to understand these conventions (Clay, 1973; Day & Day, 1981; Hiebert, 1981). A number of studies have also indicated a lack of awareness in preschool and first grade pupils about the nature of reading (Downing, 1970; Hiebert, 1981; Reid, 1966; Weintraub & Denny, 1965). Similarly, young children lack awareness of the processes and purposes of reading (Clay, 1973; Reid, 1966), and some children may even remain confused about the nature of reading despite one or even two years of school attendance (Clay, 1973; Johns, 1984).

One key study into the developmental nature of knowledge of reading by Lomax and McGee (1987) noted that children's performance on tasks related to concepts of print, graphic awareness, phonemic awareness, grapheme-phoneme correspondence knowledge and word reading improved in children ranging from 3 to 7 years old. This study is also important because it was used to test a model of the development of sight word reading. The model identified the crucial role that concepts of print and phonemic awareness play in later reading achievement.

Studies involving older children have also noted differences in metacognitive knowledge about reading as a function of age. Myers and Paris' (1978) interview study of 2nd and 6th graders showed that the younger children were less aware of the text features, made fewer references to strategies, and were less aware of factors such as prior knowledge and motivation on reading performance. A replication of the Myers and Paris (1978) study in Australia by Moore and Kirby (1981) showed similar findings.

Brown (1987) has argued that the lack of knowledge revealed by younger children relates to their newness to school learning and the fact that they are not yet strategic and deliberate readers. Metacognitive knowledge then appears to emerge slowly from early childhood and improves as children become involved in reading and instructional situations.

However, metacognitive knowledge is related not only to development, but it is also related to reading ability (see Garner, 1987 and Wong, 1987 for reviews). Some studies will be highlighted here.

A number of studies examining the relationship between children's awareness of print and reading achievement have found that poor readers are likely to lack knowledge of print conventions (Clay, 1973; Evans, Taylor & Blum, 1979; Johns, 1982). Studies of good and poor readers' awareness of strategies also reflect these ability differences. Forrest-Pressley and Waller (1981) found differences between good and better readers' knowledge of decoding strategies. Garner and Kraus (1981-1982) examined 7th graders' knowledge of strategies used to overcome comprehension difficulties and found differences in the frequency and the type of the strategies pupils mentioned. The good readers reported knowing more strategies, but also showed more awareness of the usefulness of strategies to resolve the comprehension

difficulties they detected. Paris and Myers' (1981) study of 4th graders' awareness of the usefulness of 20 comprehension strategies showed that poor readers were less aware of the detrimental effects of negative reading strategies. Good readers were more aware of problems they encountered than poor readers. The research, therefore, indicates both developmental and ability differences in metacognitive knowledge of written language and reading.

Another group of studies has investigated the relationship between metacognitive knowledge about text processing and recall and comprehension performance. These studies have shown differences between younger and older pupils (e.g., Forrest-Pressley & Waller, 1984; Pressley, Forrest-Pressley & Elliot-Faust, 1988). Schneider and his colleagues have investigated the role of domain-specific expert knowledge, alongside metacognitive knowledge and text recall (e.g., Körkel, 1987; Schneider, Körkel & Weinert, 1987; Schneider, Körkel & Weinert, 1989). Schneider, Körkel and Weinert (1987) found an empirical relationship between declarative metacognitive knowledge and procedural metacognitive knowledge. Furthermore, domain-specific "experts" and domain-specific "novices" who had high declarative metacognitive knowledge had better text recall than their novice and expert counterparts who had low declarative metacognitive knowledge. This finding suggests that high domain-specific knowledge plus high metacognitive knowledge results in the best performance (Schneider, Körkel & Weinert, 1990). Schneider, Körkel and Weinert (1987) also found that domain knowledge strongly influences procedural metacognitive knowledge.

With respect to examining the relationship between metacognition and reading in children with learning disabilities there have been an increasing number of studies (e.g., Bos & Filip, 1982; Wong & Jones, 1982, Wong, Wong, Perry & Sawaktsky, 1986). However, most of these studies are in the area of regulation of reading comprehension, in particular, intervention studies designed to teach comprehension-fostering strategies. These studies typically have shown that children with learning disabilities have difficulty in applying strategies during reading (e.g., Wong and Jones, 1982).

Little is known about the metacognitive knowledge about reading of children with learning disabilities. Where studies of metacognitive knowledge about reading in children with learning disabilities have been undertaken the results are equivocal. van Kraayenoord (1986)

found that learning disabled readers had similar metacognitive knowledge of positive strategies for gaining meaning from a story and decoding an unknown word compared with normally achieving children. In addition, the 11 and 12 year olds' awareness of self-regulatory strategies was evident in the learning disabled children's descriptions of monitoring and corrective strategy use, reasons for monitoring and judgements about success and lack of success of correction activities following comprehension monitoring tasks at two levels of difficulty. In contrast, Kavale (1980) found that children with learning problems failed to report the use of differential strategies for different comprehension question types, where as the normally achieving children did. Thus, in Kavale's study there appeared to be differences in metacognitive knowledge of strategies between the two groups. Further research is required to look specifically at learning disabled children's metacognitive knowledge about reading. This study used a longitudinal design in order to explore the possibility of a causal link between metacognitive knowledge and reading measures across time.

Method

In 1989 one hundred Grade 2 children were selected from 48 randomly selected state education and catholic independent schools. At each school a child with a learning difficulty (LD) was selected (except at two schools where two children were chosen). Children with a learning difficulty were identified by school personnel as not making progress after one year of instruction and the school was offering remedial assistance or such assistance was considered desirable. Children were excluded from the study if they clearly had an intellectual disability, an emotional disturbance, were seriously physically or sensorally disabled, or whose first language was not English. No children who had repeated a school year were included. An equal number of matched, normally achieving children (NLD) from the same classroom and who were within six months of age of the child with the learning difficulty were also selected. In all cases except for one pair the children were also matched on sex. (The boy-girl pair was dropped from these analyses). Parental consent was obtained for participation in the study. The children who began in the study in 1989 represent Cohort 1.

In 1990, a second sample of matched children with learning difficulties and without learning difficulties were selected at the same schools. This sample of children is known as Cohort 2. The procedure used to select Cohort 2 was identical to that used in Cohort 1. The sample comprised 90 children.

Measures

The measures described in this paper are part of a number of measures being used in a longitudinal study being undertaken by the Schonell Special Education Research Centre, The University of Queensland. The assessment measures of concern here relate to reading performance and megacognitive knowledge.

Reading performance

The Letter Identification Subtest of the Concepts about Print Test (Clay, 1985), the Word Identification Subtest of the Concepts about Print Test (Clay, 1985), and the Neale Analysis of Reading Ability, Revised-Form 1 (Neale, 1988) were used in the study. The Letter Identification Subtest requires children to recognize a page of printed letters of the alphabet in upper and lower case, plus two letters (a and g) in different versions. The maximum possible score was 54. The Word Identification Subtest examines children's ability to identify 15 high frequency words in isolation. The Neale Analysis of Reading Ability is a standardized instrument widely used in Australia. It consists of a collection of graded passages for establishing accuracy and comprehension of oral reading. Both accuracy scores and comprehension scores were used in this study.

Metacognitive knowledge

Metacognitive knowledge was assessed using an adapted version of the interview schedule developed by Myers and Paris (1978). This measure which we call the 'Metacognitive Knowledge Test' assesses children's metacognitive awareness of variables that influence reading. The use of an adapted version followed pilot testing which revealed wording and comprehension difficulties in some Grade 2 children on some questions. These questions were changed or deleted. Questions 1, 2, 3 a & b, 4 a & b, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, and 17 of the Myers and Paris (1978) schedule were used. The open-ended

responses to the questions were classified into categories. Where pupils gave multiple responses only the first response was used. In addition, where the child did not respond the data were coded as missing. If this occurred, it typically occurred only in the first year of data collection in each Cohort. The categories were then re-coded. A more "sophisticated" level of metacognitive knowledge (i.e., knowledge of a specific skill, specific strategy, or strategic resolution) based on the Myers and Paris (1978) results were coded as "1", while the less sophisticated response or irrelevant response was coded as "0".

Print awareness, another form of metacognitive knowledge was assessed using the Concepts about Print Subtest (Clay, 1985). This measure examines students' understanding of basic concepts of reading-related skills, such as knowledge of the language of reading, knowledge of punctuation and the conventions of print. The maximum possible score was 24.

Data Collection

The Letter Identification, Word Identification and Concepts about Print Subtests were used in the first year of the study for each Cohort. (They were considered inappropriate measures after 2 years of instruction). The Metacognitive Knowledge Test and the Neale Analysis of Reading Ability were used in each year of the study for Cohorts 1 and 2. Information from the Subtests, Metacognitive Knowledge Test and the Reading Tests was collected on 2 separate occasions at approximately 2-monthly intervals. Female research assistants, all with graduate training and extensive teaching experience, who were known to the children collected the data. Children were tested individually in a separate room in each of the schools.

Following data collection in 1989 it was noted that less than 20 children out of 100 in Cohort 1 had responded to questions 8, 9 and 10 of the adapted Myers and Paris (1978) schedule, and therefore these items were also deleted from the Metacognitive Knowledge Test. (See Appendix for final version of the Metacognitive Knowledge Test). The maximum possible score for the Metacognitive Knowledge Test was 14.

Results

One purpose of this study was to examine the change in variables across time. A second purpose was to examine the relationships between variables in terms of magnitude and directionality. In particular, interest centred on the two metacognitive variables, Concepts about Print and Metacognitive Knowledge. We were interested in the change in metacognitive knowledge across data points spread 1 year apart. The third purpose was to examine the influence of concepts about print and metacogntitive knowledge on comprehension (the goal of reading) for the 2 Cohorts. LISREL (Joreskog & Sorbom, 1984) analyses were used to examine the relationships.

The means and standard deviations for scores on the variables for the LD and NLD children in Cohorts 1 and 2 are found in Tables 1 and 2 respectively. The 9 variables of group, age, sex, accuracy, comprehension, metacognitive knowledge, letter identification, word identification and concepts about print were entered into the regression equation by Year. Analyses were undertaken separately for the 2 cohorts. Figures 1 and 2 show the statistically significant ($p \geq .05$) paths and standardized path coefficients for the two cohorts respectively. For Cohort 1, the LISREL path coefficients at Years 1989, 1990, and 1991 show that group membership influenced the variables of accuracy (.52), comprehension (.60), metacognitive knowledge (.27), letter identification (.54), word identification (.64), and concepts about print (.51) in 1989, and accuracy (.17), comprehension (.19) and metacognitive knowledge (.24) in 1990 (see Figure 1). The path coefficients for group and accuracy and group and comprehension in 1990, however, are weak. Age was found to influence accuracy in 1989 (.22). For Cohort 1 accuracy in 1989 contributed to accuracy in 1990 (.41) and in 1991 (.67) (see Figure 1). Similarly comprehension in 1989 contributed to comprehension in 1990 (.38) and in 1991 (.49) (see Figure 1). The contributions of accuracy and comprehension were stronger over time for Cohort 1. Comprehension in 1989 was also found to contribute to accuracy in 1990 (.42) in Cohort 1 (see Figure 1). Metacognitive knowledge contributed to comprehension in 1990 (.14), but this is a weak contribution (see Figure 1).

To examine more closely what occurred across time to the Metacognitive Knowledge Test scores, it is helpful to look at the performance of the LD and NLD pupils in Cohorts 1 and 2. A glance at the mean Metacognitive Knowledge Test scores for the LD and NLD children in

Cohort 1 reveals that the LD children improved their scores across time, with the LD children beginning to approach the mean scores of the NLD children by 1991 (see means and standard deviations in Table 1). The mean scores of the NLD children, in contrast, increased from 1989 to 1990, and remained the same from 1990 to 1991. The pattern of mean scores for Cohort 1 is shown in Figure 3.

The performance of the NLD children in Cohort 2 increased from 1990 to 1991, as did the mean scores on the Metacognitive Knowledge test for LD children in Cohort 2 over the same time span (see Figure 4). However the LD children's performance remained below that of the NLD children.

With reference to Figure 1, word identification in 1989 contributed to accuracy in 1991 (.24). Concepts about print in 1989 contributed to comprehension in 1990 (.19), but the coefficient is weak.

Overall the results of the path analyses for Cohort 1 suggest that the 2 metacognitive variables (concepts about print and metacognitive knowledge) in 1989 contributed to comprehension in 1990 and indirectly to comprehension in 1991. If comprehension in 1991 is treated as the criterion variable, then the results show that both the metacognitive knowledge measures in 1989, but not the metacognitive knowledge test in 1990, predicted comprehension in 1991. However, as noted earlier both of these path coefficients are weak.

For Cohort 2 the LISREL path coefficients in 1990 show that group membership strongly influenced the variables of accuracy (.63), comprehension (.68) and word identification in 1990 (.67), and to a lesser extent concepts about print (.51) and letter identification in 1990 (.35) (see Figure 2). Age contributed to word identification (.18) and concepts about print in 1990 (.21) (see Figure 2). Sex contributed to comprehension in 1991 only (.22) (see Figure 2).

Accuracy in 1990 contributed to accuracy in 1991 (.48) and negatively to metacognitive knowledge in 1991 (-.47) (see Figure 2). Comprehension in 1990 contributed to comprehension in 1991 (.79) and metacognitive knowledge in 1991 (.51) for Cohort 2 (see Figure 2). Concepts about print in 1990 contributed to metacognitive knowledge in 1991 (.32) (see Figure 2).

In terms of the overall results for Cohort 2, the pattern for the metacognitive variables indicates that neither metacognitive knowledge nor concepts about print contributed to comprehension in 1991. Therefore, in Cohort 2, the metacognitive knowledge measures did not predict comprehension performance.

The following statements summarize the main results of the path analyses for the two Cohorts.

- Group membership influenced all reading and metacognitive variables for Cohorts 1 and 2, except for Metacognitive Knowledge in Cohort 2, with LD pupils' scores being significantly lower than NLD pupils' scores at each measurement point.
- Accuracy and comprehension scores changed over time for both Cohorts.
- The Metacognitive Knowledge Test scores were not related. No links between data points for either cohort on this measure were evident.
- Metacognitive Knowledge Test scores influenced comprehension in Cohort 1, but not in Cohort 2.
- Concepts about print, a second metacognitive variable influenced comprehension in Cohort 1, but not in Cohort 2. In Cohort 2, concepts about print influenced metacognitive knowledge.

Discussion

This study sought to examine metacognitive knowledge and reading achievement as measured by several variables in a longitudinal study. Across time there was a significant, positive and direct change in children's oral reading accuracy and comprehension performance, with performance in one year improving the following year. However, a relationship between children's metacognitive knowledge about reading in one year to the next was not found.

In terms of the relationships between variables, the results indicate that comprehension performance in the first year of data collection continued to have a powerful influence on later comprehension performance, for both cohorts and also on accuracy for Cohort 1. A negative relationship between accuracy in 1990 and metacognitive knowledge in 1991 was found for

Cohort 2, but there was no link at all between these variables in Cohort 1 between 1989 to 1990, or 1990 to 1991.

With respect to the two metacognitive variables in both Cohorts across time, it is interesting to observe that there was a relationship between the two variables only in Cohort 2.

The lack of any relationship in metacognition across time, its lack of a consistent relationship with comprehension over time and Cohorts, and the inconsistent results regarding the relationship between the two metacognitive constructs which we particularly investigated in this study demand some explanation. Two possible reasons are suggested here. Firstly, the Metacognitive knowledge test may be unreliable. The use of only some of the items from the original interview schedule developed by Myers and Paris (1978) and the scoring system used in this study may have lessened the power of the measure. It is possible for us to augment the number of items used in the second and third data points in Cohort 1 and at the second data point in Cohort 2. However, then the tests would be slightly different measures, with year 1 containing fewer items than subsequent years.

Secondly, to date there have been few longitudinal studies of children's metacognitive knowledge about reading that have extended beyond a year. While it is true that several studies do show a positive relationship between metacognitive knowledge about reading and reading achievement based on correlations, or do show statistically significant differences in metacognitive knowledge about reading between groups, most studies have not examined metacognitive knowledge about reading alongside other measures. It is possible that when the field is enlarged to include other predictors of comprehension, then metacognitive knowledge about reading may not emege as a powerful predictor.

One further caution must be applied to our study. Our study involved a small sample size. As Schneider and Näslund (in press) have pointed out this has been a limitation of the few LISREL analyses of reading found in the literature. These authors have called for replication studies involving independent larger samples so that findings can be validated. Therefore, future studies with larger samples are necessary to determine the role of metacognitive knowledge on reading, to explore again and perhaps even to challenge the suggested link between metacognitive knowledge and reading, and in doing so, increase our understanding of this aspect of metacognition.

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Appendix

Questions used in final version of van Kraayenoord (1992) adapted from

Myers and Paris (1978)

Metacognitive Knowledge Test

Myers and Paris (1978) Question Number	Full Question
1	What makes someone a really good reader?
2	The other day I talked to a boy/girl who was really good at arithmetic. Then I asked him/her if he/she was a good reader. What do you think he said?
3a	Suppose there were two boys John and Alan who came from different homes. John's parents had lots of money and John had lots of toys and books. Alan's parents, though, were poor and didn't have many books at home. Do you think one of the boys was a better reader at school? Which one? John who has lots of books or Alan who doesn't?
3b	Why?
4a	One day I asked Jim to read a story that was five pages long while Tom read a story that was two pages long. Which boy took the longest to read the story?
4b	Which boy remembered the most?
5	The whole class was going to read a story about Sydney. Ann was in Sydney last summer for a holiday. Do you think that the story might be easier for Ann, who had been to Sydney, to understand, or Jane who had never been to Sydney?
6	What's your favourite kind of story? (Child's response is designated X). Say your teacher wanted you to read something, something you really didn't like as much as X. Which do you think you would read faster, X or the teacher's story?
7	Which is quicker, reading out loud or reading to yourself?
11	Do you ever tell a story that you read to someone else? What do you try to tell them? All the words or just the ending?
12	The other day I asked Bill to read a story and then to tell me what he read. Before he started reading, though, he asked me if I wanted him to remember the story word for word or just the general story. Why do you think he asked me that?
13	Which would be easier for you to do, remember the story word for word or the general story?
16	What do you do if you don't know what a word means that you read?
17	What do you do if you don't know what a whole sentence means?

Table 1

Means and standard deviations for the variables for the LD and NLD children in Cohort 1

	1989						1990						1991					
	LD			NLD			LD			NLD			LD			NLD		
	N[1]	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Accuracy	38	51.97	30.53	39	161.05	122.26	38	112.79	54.30	39	273.85	133.69	38	179.89	120.06	39	364.51	157.04
Comprehension	38	7.52	3.65	39	15.87	7.21	38	11.97	4.86	39	21.08	6.77	38	14.89	7.02	39	23.23	7.70
Meta. know.	38	9.24	1.95	39	10.20	1.45	38	10.00	1.78	39	10.51	1.50	38	10.31	1.65	39	10.51	1.41
Letter ident.	38	49.29	4.76	39	53.56	0.79												
Word ident.	38	7.94	4.20	39	13.44	2.29												
Concepts about print	38	17.80	3.00	39	21.00	2.52												

1 N = the number of individuals who had responses for each variable that appears in the LISREL model.

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Table 2

Means and standard deviations for the variables for the LD and NLD children in Cohort 2

	1990						1991					
	LD			NLD			LD			NLD		
	N[1]	M	SD	N	M	SD	N	M	SD	N	M	SD
Accuracy	42	57.98	33.57	42	135.29	58.45	42	116.45	63.80	42	217.93	83.84
Comprehension	42	8.02	3.15	42	14.52	3.94	42	9.12	4.95	42	17.02	5.31
Meta. know.	42	9.22	2.40	42	9.95	1.45	42	9.95	1.71	42	10.47	1.75
Letter ident.	42	54.45	4.45	42	52.93	1.70						
Word ident.	42	8.76	3.44	42	13.60	1.64						
Concepts about print	42	18.48	2.66	42	21.45	2.42						

1 N = the number of individuals who had responses for each variable that appears in the LISREL model.

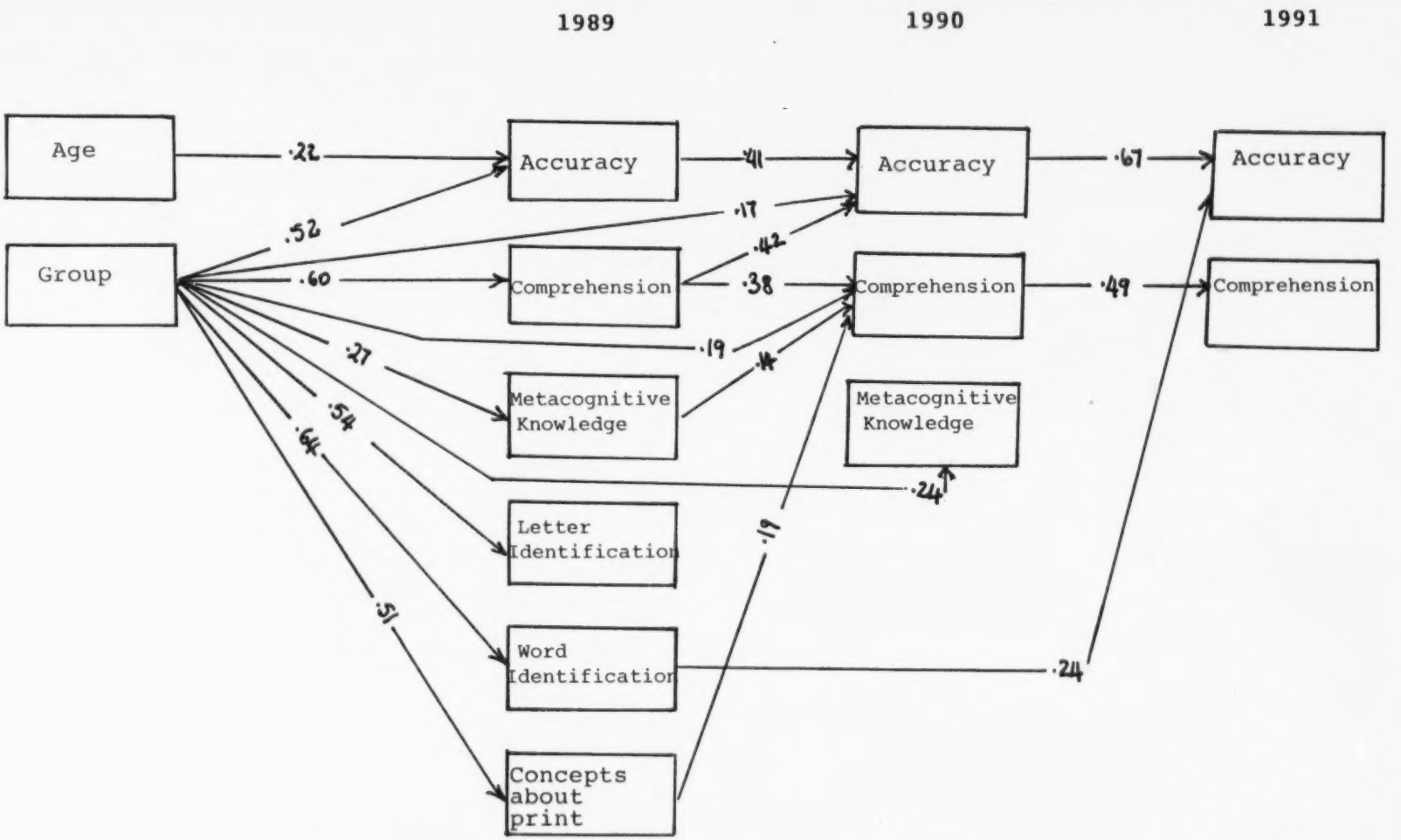

Figure 1

Statistically significant ($p \geq .05$) paths and standardized path coefficients in a longitudinal model of change (Cohort 1).

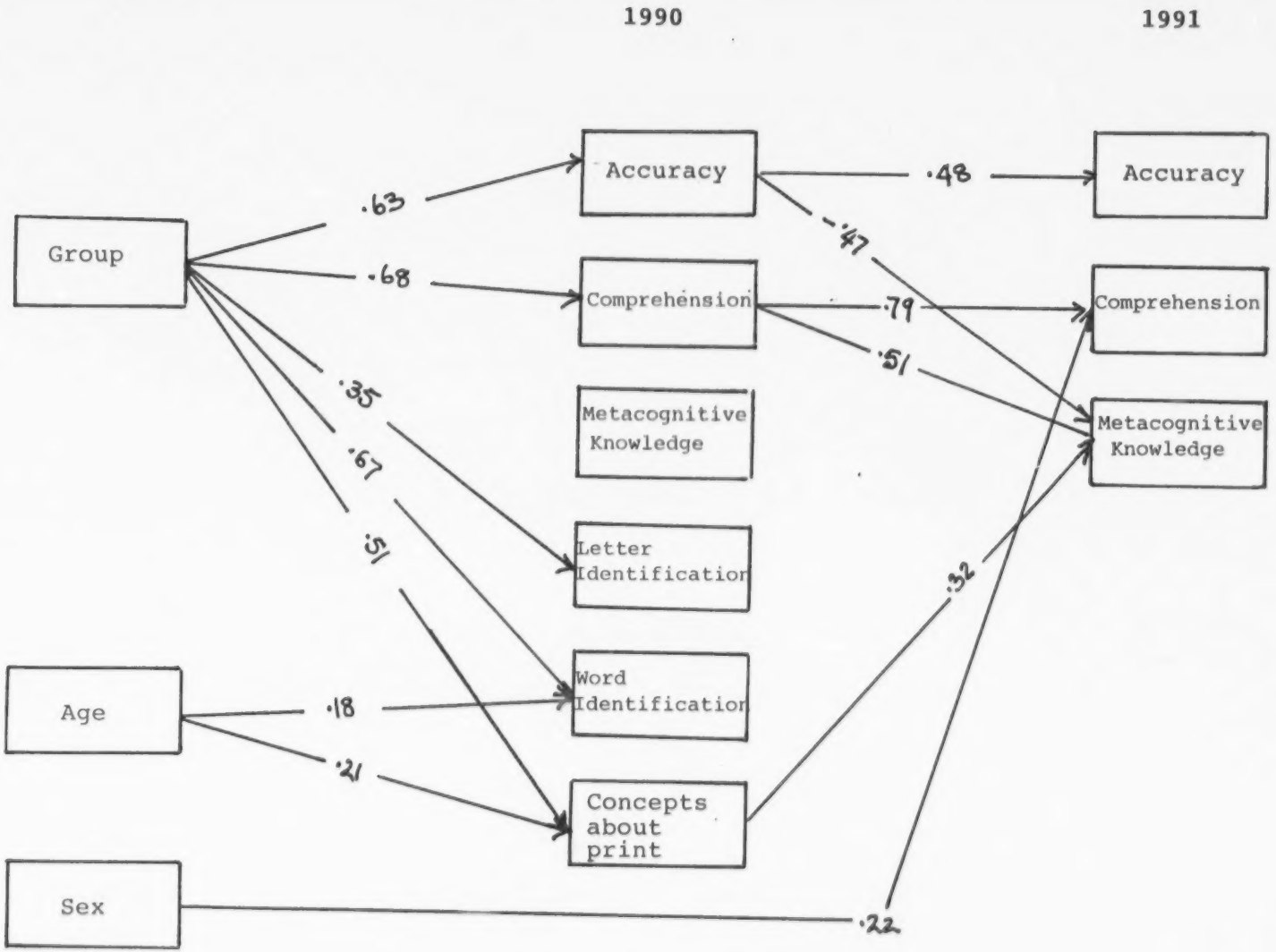

Figure 2

Statistically significant ($p \geq .05$) paths and standardised path coefficients in a longitudinal model of change (Cohort 2).

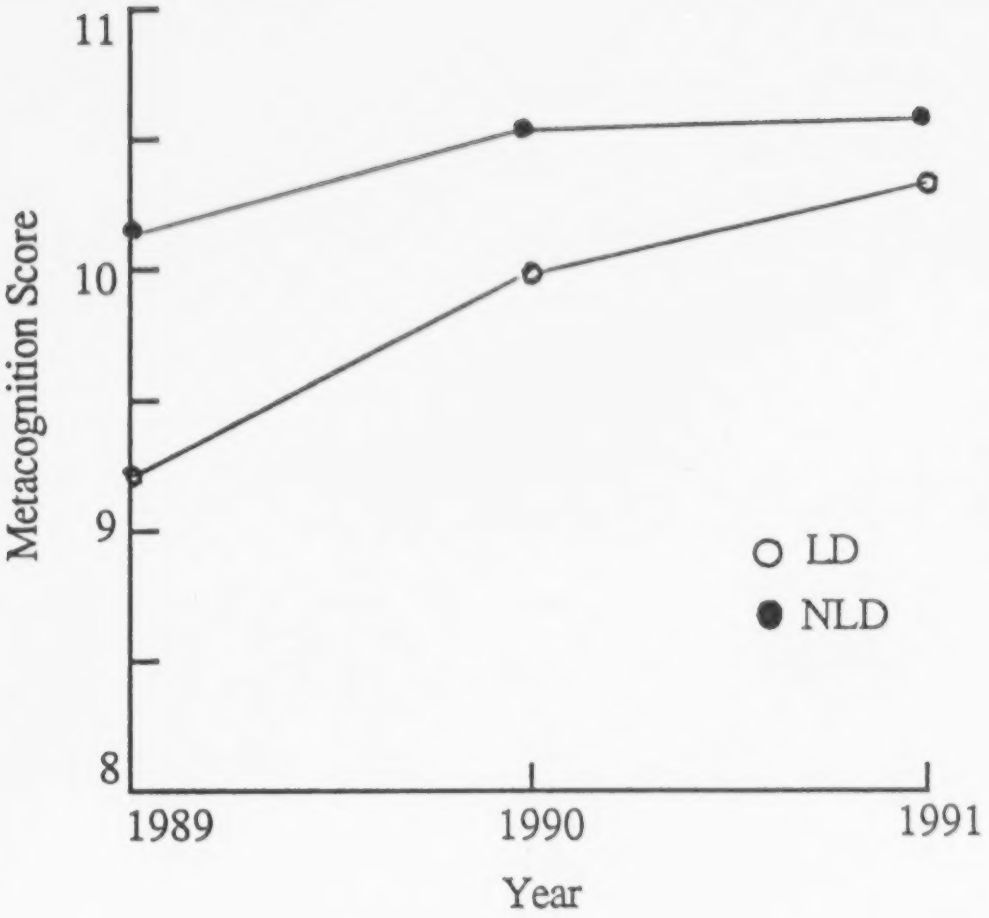

Figure 3. Mean metacognitive knowledge scores for LD and NLD children across three years for Cohort 1

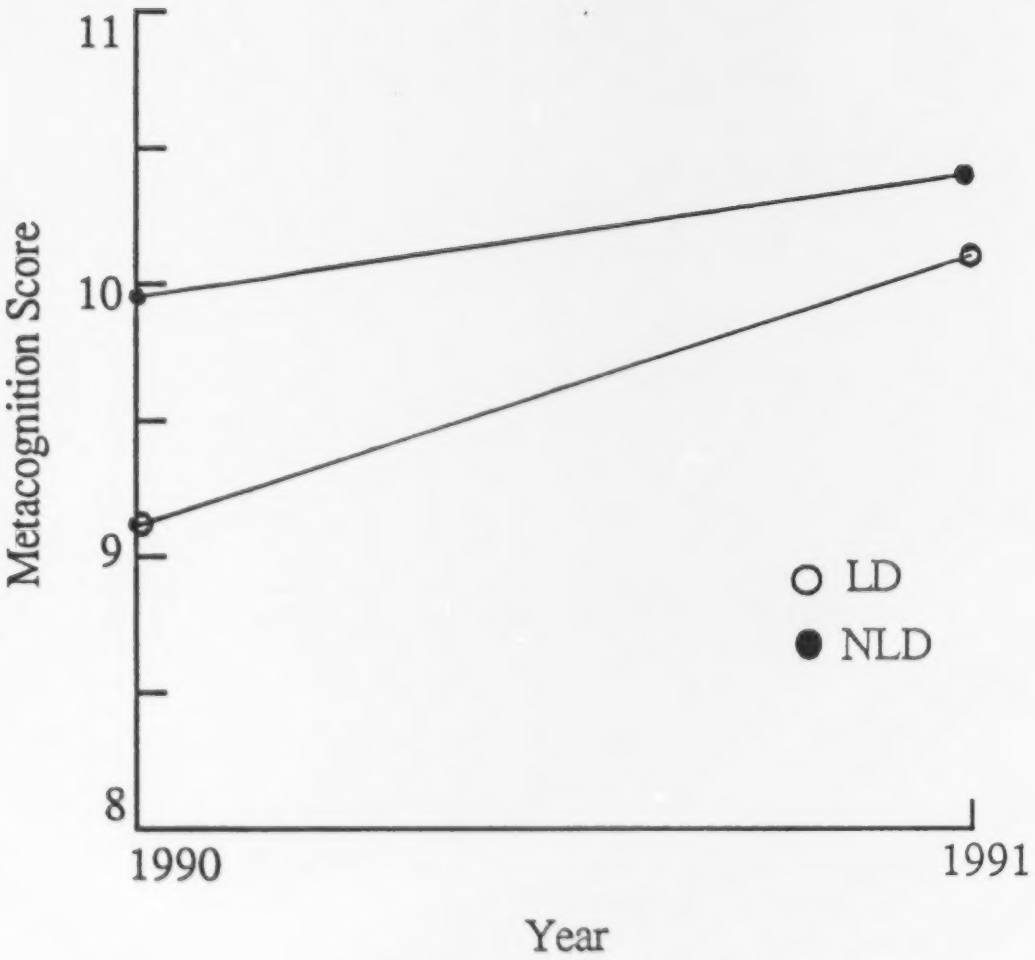

Figure 4. Mean metacognitive knowledge scores for LD and NLD children across two years for Cohort 2